# Why install a Keyphasor® transducer?

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Vibration monitoring and diagnostics systems have three purposes. First, the system should alert Operators to developing problems, while they are still manageable. Second, to minimize damage to the machine, the system should provide shutdown capability in the event of a catastrophic failure. Third, and perhaps most important, it should provide information to help the Machinery Specialist quickly and accurately diagnose machinery conditions.

The Keyphasor transducer is an essential element of a monitoring and diagnostics system because it provides both the Operator and Machinery Specialist with information vital to the successful protection and management of plant machinery. The Keyphasor signal, (Figure 2) a once-per-turn voltage pulse provided by a transducer (normally a

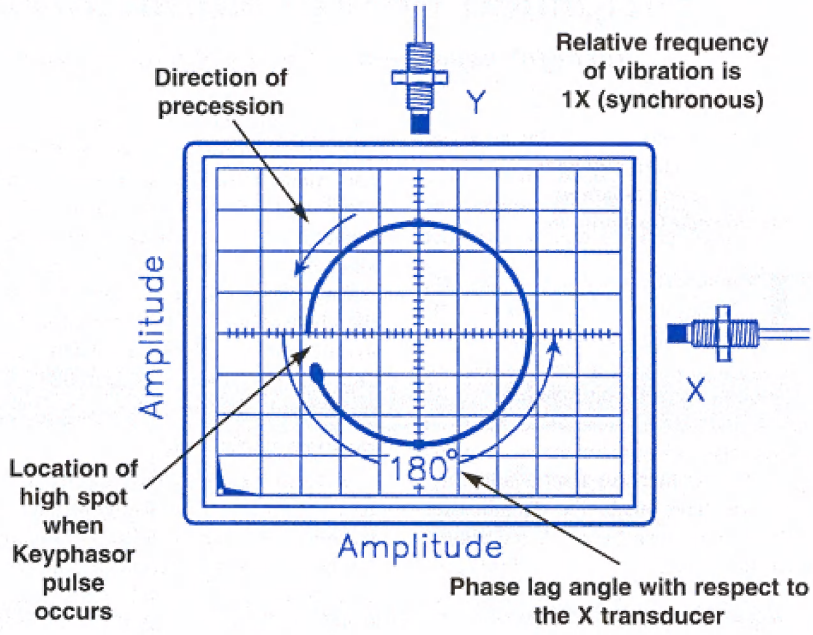


**Figure 1**
**Two (XY) proximity transducers produce a two-dimensional picture of shaft motion in the measurement plane. By examining the Keyphasor mark (the sequence of blank/bright spots) on the orbit, the direction of precession (forward or reverse) can then be determined.**

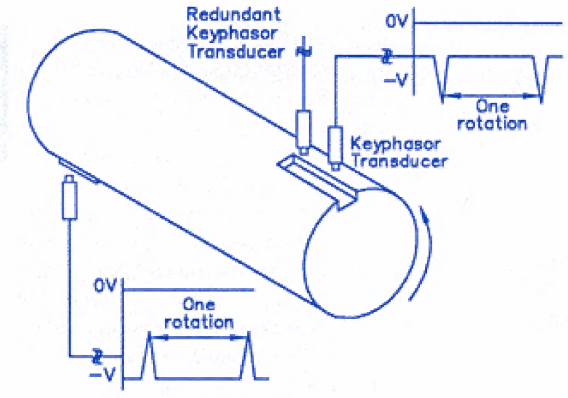


**Figure 2**
**The Keyphasor once-per-turn reference signal can come from a variety of sources: A proximity probe observing a notch or projection on the shaft, an optical pickup observing reflective tape, or a strobe light trigger using a match mark on the shaft and casing.**

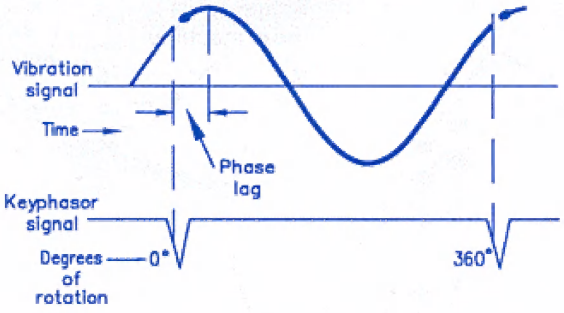


**Figure 3**
**Absolute phase is the number of degrees of vibration cycle from when the Keyphasor fires to the first positive peak in the vibration signal. It is always a lag angle, measured from 0 to 360 degrees.**

proximity probe), is used by the monitoring system to generate filtered vibration amplitude and phase lag measurements. The Keyphasor information can help the Operator identify developing machine problems or distinguish serious problems from less serious ones.

### Information for the Operator

In the past, Operators were only required to manage the process. In today's competitive environment, they are expected to manage not only the process, but plant assets, including machinery. In some plants, the Operator can call a Machinery Specialist to analyze machinery data and determine what should be done. However, in many plants, a specialist may not be immediately available. If the Operator only has direct (or overall) vibration amplitude measurements, it is difficult to decide whether the machinery problem is serious or not.

A permanently-installed Keyphasor transducer provides the Operator with phase information which can help him detect subtle changes to the machinery. Operators can use the Bently Nevada 3500 Machinery Data Management System, the Trendmaster® 2000 System or the Data Manager® 2000 System for Windows NT™ to generate industry-standard plots that display 1X (synchronous) amplitude and phase or NOT 1X (nonsynchronous) amplitude measurements. These Bently Nevada systems were designed to present 1X and NOT 1X information in a way that is easy for Operators to measure. Operators can easily compare the 1X portion of the vibration signal to the NOT 1X portion.

Changes in 1X vibration need to be analyzed. If the change is gradual, the Operator can schedule a visit by the Machinery Specialist. Then, the operator can continue to manage his machinery and process with increased attention. If the change is sudden, an immediate call to the specialist is in order, and the Operator can apply the appropriate management procedure to this new situation.

### Serious machine problems

A change in the NOT 1X portion of the overall vibration, however, is often a strong indicator of malfunctions that can quickly be detrimental to the machine. If there has been an increase in NOT 1X vibration, a Machinery Specialist should be called immediately. Some of the most common causes of NOT 1X vibration are fluid-induced instabilities, rotor-to-stator rubs, and gear faults. All are of immediate concern.

### Information for the Machinery Specialist

The Machinery Specialist also needs machinery information from a Keyphasor transducer to perform his job properly. Although some plot formats, such as shaft orbits and spectrum displays, will be available, a Keyphasor mark on orbit plots (Figure 1) is necessary to evaluate phase lag. Without the Keyphasor mark, the shaft orbit will not indicate if the vibration is occurring in a synchronous (1X) or nonsynchronous mode. A Keyphasor mark is also necessary to determine the direction of shaft vibration precession (in the same or the opposite direction of shaft rotation) from the orbit, and to generate the mode shape of the shaft (Figure 4).

In addition, polar and Bode plots, which are necessary to document rotor response on startup or shutdown, cannot be developed without Keyphasor information. These plots are also needed for accurate balancing. Before any balancing solutions are attempted, polar plots should be reviewed to verify where the weights should be placed.

The Machinery Specialist needs to review as much machinery data as possible to provide an accurate analysis. The lack of Keyphasor-related data can lead to an incorrect diagnosis.

It is sometimes difficult to install a Keyphasor transducer. However, the additional information provided by the Keyphasor signal is absolutely necessary for Operators and Machinery Specialists to successfully protect and manage machinery. For this reason, both Bently Nevada and the American Petroleum Institute, in its specifications for machinery protection systems, recommend installing a Keyphasor transducer and a redundant Keyphasor transducer. ■

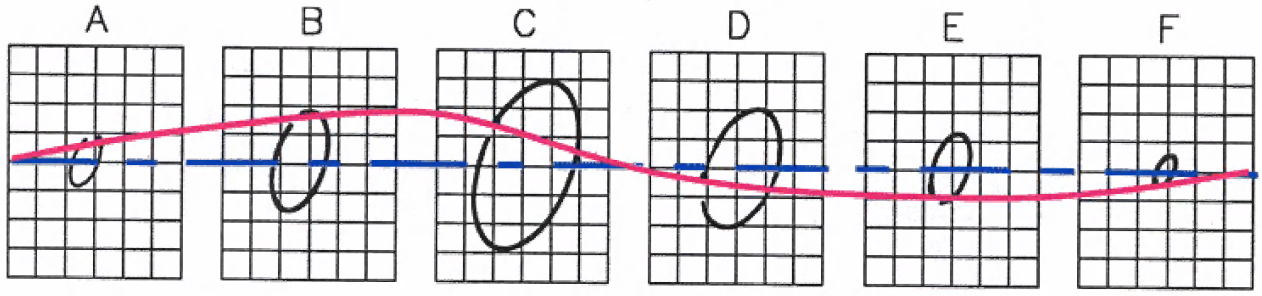


**Figure 4**
**Example of mode shape**

**A through F above are orbits shown at the same speed at different bearings. The blue dashed line represents the orbit centerline. The red line connecting the Keyphasor dots shows the apparent shaft deflection shape.**